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Binary Logic-Based Blood Typing System Kit
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Background: The determination of an individual's blood type is an essential diagnostic procedure that serves as a cornerstone in numerous clinical and emergency medical scenarios. Blood typing plays a critical role in ensuring compatibility for blood transfusions, organ transplants, and hematological evaluations. The most clinically significant blood group systems are the ABO and Rh (Rhesus) systems. The ABO system classifies blood into four main groups—A, B, AB, and O—based on the presence or absence of antigens on the surface of red blood cells. The Rh system, primarily concerned with the D antigen, further categorizes each ABO group as either Rh-positive or Rh-negative. In total, this classification yields eight standard blood types: A+, A−, B+, B−, AB+, AB−, O+, and O−. Accurate typing of these blood groups is critical because incompatibility during transfusion or transplantation can result in immune reactions that are potentially fatal.
Aims: The desired improvements in this space include, but are not limited to, enhanced portability, intuitive interpretation, digital integration, contamination resistance, and logical simplification of the output process.
Methods: In a first implementation of the invention, a disposable blood typing device for determining an ABO and RhD blood type of a blood sample, comprises:

(a) a housing comprising a plurality of test zones including

(i) a first test zone containing an anti-A reagent configured to detect an A antigen in the blood sample,

(ii) a second test zone containing an anti-B reagent configured to detect a B antigen in the blood sample, and

(iii) a third test zone containing an anti-D reagent configured to detect a D antigen in the blood sample;

(b) a sample application area in fluid communication with each of the plurality of test zones;

(c) a result output mechanism associated with each test zone and configured to display a binary output comprising a first state indicating presence of antigen and a second state indicating absence of antigen; and

(d) a logical mapping structure operatively associated with the result output mechanism and configured to associate the combination of binary outputs from the first, second, and third test zones with a specific ABO and RhD blood type classification.

In a second aspect, the result output mechanism may comprise a colorimetric indicator configured to change color in response to an agglutination reaction in each respective test zone.
In another aspect, the result output mechanism may comprise an electronic indicator selected from the group consisting of a light-emitting diode (LED), a digital display, or a visual signal on a screen.

In another aspect, each test zone may be operatively coupled to a corresponding LED that illuminates in a first color in response to a positive reaction and in a second color in response to a negative reaction.
In another aspect, the logical mapping structure may comprise a preconfigured Boolean logic circuit that receives the binary outputs from the test zones and generates an output signal corresponding to the determined blood type.
In another aspect, the logical mapping structure may comprise a printed chart or matrix on the housing that maps all possible binary combinations to corresponding blood type classifications.
Results: One input of a blood sample with only one possible output of binary logic-based blood typing output results.
Summary / Conclusions: The present invention is directed to a disposable blood type testing kit configured to identify an individual's ABO and RhD blood group through a simplified logic-based detection mechanism.